

DOCUMENT RESUME

ED 191 689

SE 031 773

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 TITLE Key Competencies, Mathematics Education: Elementary Schools (E-MATH).
 INSTITUTION Philadelphia School District, Pa. Office of Curriculum and Instruction.
 PUB DATE 80
 NOTE 28p.; For related document, see SE 031 774.
 EDRS PRICE MF01/PC02 Plus Postage.
 DESCRIPTORS *Basic Skills; Behavioral Objectives; Cognitive Development; Competence; *Curriculum Guides; Elementary Education; *Elementary School Mathematics; Evaluation; *Mathematics Curriculum; *Mathematics Education; Mathematics Instruction; Mathematics Materials; *Program Descriptions; Student Characteristics; Teacher Effectiveness

ABSTRACT

The key student competencies of mathematics education for the School District of Philadelphia, grades one through six, are presented. This book is one of two describing the school system's entire mathematics program. The philosophy stated is that mathematics education should prepare students with the mathematics competencies required to function successfully as a citizen, worker, and consumer. Effective living is increasingly dependent on one's proficiency in mathematics. All students can and should learn mathematics from elementary through high school. Descriptions of the key competencies provided at each level are the bulk of this publication. Problem solving is a stated major goal in the program and is reflected in the competencies listed. (MP)

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KEY COMPETENCIES

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MATHEMATICS ELEMENTARY SCHOOLS

OFFICE OF

CURRICULUM and INSTRUCTION

• THE SCHOOL DISTRICT OF PHILADELPHIA •



SE 031 773

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Key Competencies

MATHEMATICS EDUCATION
(Elementary)
(E-MATH)

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1980

THE SCHOOL DISTRICT OF PHILADELPHIA
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File #200
June 2, 1980

Dear Colleagues:

The School District of Philadelphia is committed to quality education for all its students. In this regard, two recent events are of particular significance: the Board of Education resolution reaffirming the use of mandated curricula and the Superintendent's "Blueprint for Academic Achievement." All schools, unless receiving official approval to do otherwise, are to use the School District's courses of study; all students are to be considered as having high potential.

The "Blueprint" calls for the identification of essential learning for each grade. To assist principals and teachers, the Office of Curriculum and Instruction has prepared "Key Competencies" for the mandated subjects. With each competency are behavioral objectives which can be used to evaluate mastery of the competency. The lists are comprehensive and coded for easy reference. Each publication contains the sequence of competencies for either elementary or secondary subjects thus providing a perspective of learning over a period of time. Copies are being distributed to all personnel directly involved with instruction.

It should be noted that the term *key competency* signifies the opening of the door to learning. In no way should mastery of these competencies be considered the limit of education. The courses of study provide a full array of content and activities. On the other hand, failure to master the key competencies should be a signal for intensive evaluation of the effectiveness of the educational program - a process calling for collaborative effort of school, home, and if need be, community.

A curriculum publication is, by its very nature, always in a state of development. Your review of this document is eagerly sought and your recommendations will be deeply appreciated. Please send your comments to me. I am as close to you as your phone.

With every good wish.

BERNARD G. KELNER
Associate Superintendent
Curriculum and Instruction

BGK/ar

MATHEMATICS EDUCATION

The mathematics education program prepares students with the mathematics competencies required to function successfully as a citizen, worker, and consumer. Effective living is increasingly more dependent on one's being proficient in mathematics.

Problem-solving is a major goal in the program. The mathematics program takes full advantage of the power of the calculator and computer at all grade levels.

The competencies are derived from a flexible curriculum with a wide range of options designed to accommodate the diverse needs of students in an urban environment.

The philosophy of the mathematics program is predicated on the assumption that all students can and should learn mathematics from elementary through high school.

The scope of the mathematics program is for grades one through twelve.

The booklet will treat the key competencies in the elementary program (grades one through six).

The following coding system was used to designate the competencies:

Example:

E - MATH - 2 - 3
 3rd Competency
 2nd Year (Grade 2)
 Mathematics
 Elementary

01 - Student Outcome 1

02 - Student Outcome 2

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Note: The following courses are given in the elementary program:

E - MATH - 1 - 1st year (Grade 1)
E - MATH - 2 - 2nd year (Grade 2)
E - MATH - 3 - 3rd year (Grade 3)
E - MATH - 4 - 4th year (Grade 4)
E - MATH - 5 - 5th year (Grade 5)
E - MATH - 6 - 6th year (Grade 6)

For further information regarding mathematics education, its curriculum and services, please refer to Curriculum Means Services or contact:

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ELEMENTARY MATHEMATICS
(E-MATH-1)

Key Competencies

Grade 1
Levels 1, 2, 3

E-MATH-1-1

STUDENTS WILL DEMONSTRATE UNDERSTANDING AND SKILL WITH
THE DECIMAL SYSTEM OF NUMERATION:

01. Count to 100.
02. Count by tens to 100.
03. Count backward 20 - 1.
04. Count objects to 20.
05. Understand meaning of zero.
06. Use ordinal numbers to 20th.
07. Read 1 - 50.
08. Write 1 - 50.
09. Use a 1 - 30 number line.
10. Understand order (before, after, between) of numbers to 50.
11. Recognize repeating pattern of digits.

E-MATH-1-2

STUDENTS WILL DEMONSTRATE SKILL IN COMPUTATION WITH
WHOLE NUMBERS:

01. Know addition and subtraction facts to 9.
02. Add three or more addends to 9.
03. Read and write greater than and less than symbols ($>$ & $<$) for numbers to 9.
04. Understand $a + b$ (e.g., $2 + 3$) & $a - b$ as names for numbers.

Grade 1
Levels 1, 2, 3

E-MATH-1-2

STUDENTS WILL DEMONSTRATE SKILL IN COMPUTATION WITH WHOLE NUMBERS (continued):

05. Solve for the missing addend (e.g., $5 + \square = 8$)
06. Recognize commutative and associative properties of addition.
07. Recognize that adding zero to, or subtracting zero from, a number does not change the number.
08. Recognize numbers greater than or less than a given number to 9.
09. Understand subtraction as the inverse of addition.
10. Use the number line to solve problems.

E-MATH-1-3

STUDENTS WILL DEVELOP CONCEPTS OF FRACTIONAL NUMBERS:

01. Divide a region into equal parts.
02. Divide a set into equivalent subsets.
03. Recognize "half" as one of two equal parts.
04. Separate a set containing 2 or 4 elements into two equivalent subsets.
05. Recognize "quarter" as one of four equal parts.
06. Separate a set containing 4 or 8 elements into four equivalent subsets.

E-MATH-1-4

STUDENTS WILL DEVELOP CONCEPTS OF MEASUREMENT:

01. Use a balance to compare weights.
02. Tell time by hours, half-hours and quarter-hours.
03. Know the number of days in a week and months in a year.

Grade 1
Levels 1, 2, 3

E-MATH-1-4

STUDENTS WILL DEVELOP CONCEPTS OF MEASUREMENT (continued):

04. Identify a specific day, date, month and year from a calendar, i.e., can read a calendar.
05. Distinguish between high and low temperatures.
06. Recognize the degree as a unit of measure.
07. Read a thermometer.
08. Relate temperatures to seasons.
09. Recognize penny, nickel and dime.
10. Know values of penny, nickel and dime.
11. Relate dime to penny and nickel.
12. Recognize cup, pint and quart (liquid).
13. Recognize yard and foot and relationship between the two.

E-MATH-1-5

STUDENTS WILL DEMONSTRATE SKILL IN ORGANIZING AND INTERPRETING DATA:

01. Read a pictograph, simple line graph and simple bar graph.
02. Use tables of addition and subtraction facts.

E-MATH-1-6

STUDENTS WILL DEVELOP BASIC GEOMETRIC CONCEPTS:

01. Match simple shapes.
02. Recognize and name circle, rectangle, square and triangle.
03. Arrange shapes in size sequence.
04. Understand a point as a location in space.

Grade 1
Level 1, 2, 3

E-MATH-1-6

STUDENTS WILL DEVELOP BASIC GEOMETRIC CONCEPTS (continued):

- 05. Use a dot to represent a point.
- 06. Understand that space is the set of all points.

ELEMENTARY MATHEMATICS
(E-MATH-2)

Key Competencies

Grade 2
Levels 4 and 5

E-MATH-2-1

STUDENTS WILL DEMONSTRATE UNDERSTANDING AND SKILL WITH THE DECIMAL SYSTEM OF NUMERATION:

01. Count forward by 1's to 500, starting with any number.
02. Count forward by 2's and 5's to 100.
03. Count backward by 1's, 2's and 10's from 100.
04. Read and write numerals to 500.
05. Read numerals by name or value (24 = two tens, four ones; twenty-four ones).
06. Read expanded notation ($25 = 20 + 5$).
07. Use ordinal numbers to 100th.
08. Count ascending and descending series of 2's and 10's to 100.
09. Count odd and even numbers to 100.

E-MATH-2-2

STUDENTS WILL DEMONSTRATE SKILL IN COMPUTATION WITH WHOLE NUMBERS:

01. Use parentheses () to indicate a binary grouping when using 3 or more addends in horizontal form.
02. Add and subtract tens from 90.
03. Multiply and divide as inverse operations with products to 10.
04. Use multiplication as repeated addition; division as repeated subtraction.
05. Use the array as a pictorial representation of multiplication.

Grade 2
Levels 4 and 5

E-MATH-2-2

STUDENTS WILL DEMONSTRATE SKILL IN COMPUTATION WITH WHOLE NUMBERS (continued):

06. Use the sign for multiplication ($\times$) and division ($\div$).
07. Solve for the missing factor using open sentences.
08. Create and solve simple word problems using number line, pictorial and concrete representations.
09. Round off numbers to the nearest ten.
10. Record different names for the same number.
11. Use expanded notation to record a number ($36 = 30 + 6$).
12. Read and write addition and subtraction facts to 18.
13. Add and subtract tens and ones without regrouping.
14. Read and write multiplication and division facts to 18.
15. Use the identity element of multiplication and division.
16. Use " $\frac{1}{2}$ of" as a way to record division.
17. Translate simple word problems into open sentences.

E-MATH-2-3

STUDENTS WILL DEMONSTRATE UNDERSTANDING AND SKILL IN THE USE OF FRACTIONAL NUMBERS:

01. Identify a third as one of three equal parts.
02. Compare halves, thirds, and fourths with different units.
03. Arrange fractional parts of units concretely in size sequence, from smallest to largest, and largest to smallest.

Grade 2
Levels 4 and 5

E-MATH-2-4

STUDENTS WILL DEMONSTRATE SKILL IN THE AREA OF
MEASUREMENT:

01. Count in inches.
02. Construct a ruler with units of inches.
03. Compare the relationship between an inch and a foot, between an inch and a yard.
04. Use before and after the hour.
05. Identify the number of weeks in a year.
06. Identify and compare, as fractional parts, the relationship between one-half of a cup, half-pint, pint, quart, and gallon.
07. Construct a table showing liquid measure equivalents (see Sec. 5).
08. Read and use the symbol for degrees ($^{\circ}$).
09. Identify the value of a quarter.
10. Compare the relationship between a penny, nickel, dime, and quarter.
11. Use scales and balances to find weights of objects.
12. Measure by the pound.
13. Count and identify quantities that represent "a dozen."
14. Use $\frac{1}{2}$ inch as a unit of measure.
15. Relate $\frac{1}{2}$ foot to inches.
16. Read, illustrate and record time by the hour, half-hour, and quarter-hour.
17. Identify the freezing point of water.

Grade 2
Levels 4 and 5

E-MATH-2-4

STUDENTS WILL DEMONSTRATE SKILL IN THE AREA OF MEASUREMENT (continued):

18. Compare the value of a dollar and half-dollar, using the symbol \$.
19. Use the decimal point to separate dollars from cents.
20. Weigh and record ounces.

E-MATH-2-5

STUDENTS WILL DEMONSTRATE SKILL IN ORGANIZING AND INTERPRETING DATA:

01. Construct a table showing equivalent liquid measures (see Sec. 4).
02. Construct and interpret bar, line, and pictographs.

E-MATH-2-6

STUDENTS WILL DEMONSTRATE SKILL IN BASIC GEOMETRIC CONCEPTS:

01. Identify a curve as a set of points which make a path.
02. Identify a line segment as a special curve (a straight path).
03. Use the straight edge.
04. Identify end points named by capital letters.
05. Read and construct line segments using the symbol $\overline{AB}$.
06. Identify a line as a set of points continuing infinitely in both directions.

ELEMENTARY MATHEMATICS
(E-MATH-3)

Key Competencies

Grade 3
Levels 6 and 7

E-MATH-3-1

STUDENTS WILL DEMONSTRATE UNDERSTANDING AND SKILL WITH THE DECIMAL SYSTEM OF NUMERATION:

01. Count from 1 to 1000.
02. Count forward and backwards by 1,000's to and from 10,000.
03. Count by 3's and 4's to 50.
04. Read four-digit numerals to 9999.
05. Use "thousand" as the name for the fourth place to the left.
06. Use "hundred" as the name for the third place to the left.
07. Rename 1000's as hundreds, tens, and ones (positional notation).
08. Use zero (0) in positional notation.
09. Use the comma to separate hundreds from thousands.
10. Write numerals to 1000.
11. Count series of 3's and 4's to 1000.

E-MATH-3-2

STUDENTS WILL DEVELOP SKILL IN COMPUTATION WITH WHOLE NUMBERS:

01. Identify numbers "greater than" and "less than" to 500.
02. Round-off numbers to the nearest ten, hundred or thousand.
03. Use a fractional part of a group as a way of naming a number:

$\frac{1}{2}$ of 12 is another name for 6.

Grade 3
Levels 6 and 7

E-MATH-3-2

STUDENTS WILL DEVELOP SKILL IN COMPUTATION WITH WHOLE NUMBERS (continued):

04. Rename numbers using positional and expanded notation to record 100's.
05. Add and subtract by bridging a ten.
06. Add 3 or more addends of two and three digits with and without regrouping.
07. Add and subtract by endings.
08. Add and subtract tens and ones with regrouping using expanded notation in vertical and horizontal forms.
09. Multiply and divide with products to 81.
10. Multiply tens and ones without regrouping.
11. Use zero (0) in multiplication.
12. Use the distributive property or multiplication over addition.
13. Record division in three ways ($2 \overline{)4}$; $4 \div 2 = 2$; $\frac{1}{2}$ of 4 = 2).
14. Divide with a remainder using products to 90.
15. Recognize that division by zero (0) is meaningless.
16. Solve simple oral and written one - and two-step problems.

E-MATH-3-3

STUDENTS WILL DEMONSTRATE UNDERSTANDING AND SKILL IN THE USE OF FRACTIONAL NUMBERS:

01. Use $\frac{1}{2}$, $\frac{1}{4}$, and $\frac{1}{3}$ as unit fractional numbers (using regions, sets, and number lines).

Grade 3
Levels 6 and 7

E-MATH-3-3

STUDENTS WILL DEMONSTRATE UNDERSTANDING AND SKILL IN THE USE OF FRACTIONAL NUMBERS (continued):

02. Develop the sequence of fractional numbers using the number line and identifying equivalent fractions (halves, fourths, thirds).

E-MATH-3-4

STUDENTS WILL DEMONSTRATE SKILL IN THE USE OF MEASUREMENT TECHNIQUES:

01. Identify $\frac{1}{2}$ and $\frac{1}{4}$ of a yard, foot, and inch.
02. Compare $\frac{1}{4}$ of a yard and $\frac{1}{4}$ of a foot to inches.
03. Differentiate between A.M. and P.M., noon and midnight.
04. Tell time using 5-minute intervals.
05. Compare lengths of time:
 - a. Hour
 - b. Half-hour
 - c. Quarter-hour
 - d. Five minutes
06. Identify one-half year in relation to weeks and months.
07. Compute the number of days from one date to another.
08. Use fractional parts of $\frac{1}{4}$ of a cup, a quart, a gallon.
09. Change one unit of liquid measure to another:
 - a. Quarts to pints
 - b. Pints to quarts
10. Recognize the relationship between U.S. money and the decimal system.

**Grade 3
Levels 6 and 7**

E-MATH-3-4 **STUDENTS WILL DEMONSTRATE SKILL IN THE USE OF MEASUREMENT TECHNIQUES (continued):**

11. Compute with U.S. money using the decimal form.
12. Relate $\frac{1}{2}$ pound to ounces.
13. Use scales and balances to determine weight of one-quarter pound (relate to ounces).
14. Find and record differences in temperature.

E-MATH-3-5 **STUDENTS WILL DEMONSTRATE COMPETENCY IN ORGANIZING AND INTERPRETING DATA:**

01. Organize and interpret data using bar, line, and pictographs, gathering information from class activities.

E-MATH-3-6 **STUDENTS WILL DEMONSTRATE SKILL IN BASIC GEOMETRY:**

01. Identify examples of simple closed curves through recognition of triangles, squares and the circles.
02. Identify examples of a plane as an infinite set of points and an infinite number of lines represented by a picture or drawing of any flat surface.

ELEMENTARY MATHEMATICS
(E-MATH-4)

Key Competencies

Grade 4
Levels 8 and 10

E-MATH-4-1

STUDENTS WILL DEMONSTRATE SKILL IN SYSTEMS OF NUMERATION:

01. Count by 6's, 7's, 8's, and 9's to 100.
02. Read and write numerals to 9,999.
03. Use expanded notation for thousands.
04. Write place value to 10,000.
05. Read Roman numerals I - XII.

E-MATH-4-2

STUDENTS WILL DEMONSTRATE SKILL IN COMPUTATION WITH
WHOLE NUMBERS:

01. Use the properties of addition and multiplication: closure, commutative, associative, identity element.
02. Add and subtract, bridging a ten.
03. Add 3 or more addends of 2-digit numerals with regrouping.
04. Add and subtract hundreds with and without regrouping.
05. Multiply hundreds by ones with and without regrouping.
06. Divide, using repeated subtraction.
07. Divide hundreds by ones, with and without remainders using the "long division" algorithm.
08. Read, write and interpret open sentences.
09. Solve simple 2-step problems by writing mathematical sentences.

Grade 4
Levels 8 and 10

E-MATH-4-3

STUDENTS WILL DEMONSTRATE SKILL IN USING FRACTIONAL NUMBERS:

01. Relate fractions to division: ($8 \div 2$ same as $\frac{8}{2}$ or 4).
02. Construct and use physical models (unit regions, congruent regions, number lines, unit segments), for fractional numbers less than 1 (value ≤ 1). Use appropriate fractional symbols.

E-MATH-4-4

STUDENTS WILL DEMONSTRATE SKILL IN THE USE OF MEASUREMENT TECHNIQUES:

01. Use fractional parts ($\frac{1}{3}$ of a yard, foot, etc.) in measurement.
02. Use the ruler to measure fractions of an inch to $\frac{1}{8}$. Include $\frac{1}{4}$ ft., $\frac{1}{4}$ yd., $\frac{1}{3}$ yd.
03. Compare and combine different units of length (denominate numbers).
04. Record time using the colon (:).
05. Tell time using one-minute intervals.
06. Tell time using Roman numerals I - XII.
07. Differentiate between a leap year and a regular year.
08. Use the century as a unit of time.
09. Use the ton as a unit of weight.

E-MATH-4-5

STUDENTS WILL DEMONSTRATE SKILL IN ORGANIZING AND INTERPRETING DATA:

01. Construct and use a slide rule for addition and subtraction.

Grade 4
Levels 8 and 10

E-MATH-4-5

STUDENTS WILL DEMONSTRATE SKILL IN ORGANIZING AND INTERPRETING DATA (continued):

02. Construct simple scale drawings.
03. Construct and interpret simple bar graphs, using intervals of 2 and 5 on the vertical axis.

E-MATH-4-6

STUDENTS WILL DEMONSTRATE SKILL IN BASIC GEOMETRY:

01. Identify a region as the interior of any simple closed curve.
02. Classify regions by the number of sides.
03. Identify a ray as a line with one endpoint, extending infinitely in one direction.

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ELEMENTARY MATHEMATICS
(E-MATH-5)

Key Competencies

Grade 5
Levels 11, 12, and 13

E-MATH-5-1

STUDENTS WILL DEMONSTRATE SKILL IN SYSTEMS OF
NUMERATION:

01. Read and write numerals of 6 places
(100,000 - 999,999).
02. Read and write Roman numerals to CCC.

E-MATH-5-2

STUDENTS WILL DEMONSTRATE SKILL WITH THE COMPU-
TATION OF WHOLE NUMBERS:

01. Identify patterns in addition and
multiplication tables.
02. Add and subtract 5-place numbers, with
and without regrouping. Use expanded
notation to analyze the operation.
03. Add, subtract, multiply and divide
U.S. money.
04. Multiply 4-place numbers by ones with
and without regrouping.
05. Multiply hundreds by tens and hundreds.
06. Use factors and primes with appropriate
terminology: factor, product, product
expression, prime number, composite
number.
07. Divide thousands by ones.
08. Use literal numbers.

E-MATH-5-3

STUDENTS WILL DEMONSTRATE SKILL IN WORKING WITH
FRACTIONAL NUMBERS:

01. Construct and use physical models
(congruent regions, number lines, etc.)
for fractional numbers greater than 1
(value > 1).

Grade 5
Levels 11, 12, and 13

E-MATH-5-3

STUDENTS WILL DEMONSTRATE SKILL IN WORKING WITH FRACTIONAL NUMBERS (continued):

02. Compute to find equivalent fractions changing to higher and lower terms, and comparing.
03. Use improper fractions and mixed forms.
04. Compare decimal fractions to whole numbers using place value.
05. Read and write decimal fractions to thousandths.
06. Order decimals.

E-MATH-5-4

STUDENTS WILL DEMONSTRATE SKILL WITH MEASUREMENT TECHNIQUES:

01. Construct and read timetables.
02. Read and record dates numerically (1-14-80).
03. Develop methods of determining perimeter with and without calculations.
04. Use A.D. and B.C.
05. Compare area using regions.
06. Use square inch, square foot, and square yard.
07. Read the Fahrenheit thermometer using above and below zero.
08. Relate a ton to pounds.

E-MATH-5-5

STUDENTS WILL DEMONSTRATE SKILL IN ORGANIZING AND INTERPRETING DATA:

01. Use average (mean) as a statistical method.

Grade 5
Levels 11, 12, and 13

E-MATH-5-6

STUDENTS WILL DEMONSTRATE SKILL IN GEOMETRY:

01. Identify and classify triangles (isosceles, equilateral) and quadrilaterals (rectangles, squares).
02. Work with diameters and radii of circles.
03. Identify solid geometric figures (spheres, cubes, cylinders, cones, pyramids).
04. Use the straightedge, compass, and protractor.
05. Identify two points on a plane as determining a line.

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ELEMENTARY MATHEMATICS
(E-MATH-6)

Key Competencies

Grade 6
Levels 14 and 15

E-MATH-6-1

STUDENTS WILL DEMONSTRATE SKILL WITH WHOLE NUMBER OPERATIONS:

01. Round off numbers to the nearest thousand and ten-thousand.
02. Find common and prime factors of a number.
03. Find and use the greatest common factor (G.C.F.) of two numbers.
04. Find and use the least common multiple (L.C.M.) of two numbers.
05. Divide by 2-place divisors with remainders, using long and short forms.
06. Read, write and order positive and negative integers.

E-MATH-6-2

STUDENTS WILL DEMONSTRATE SKILL IN USING FRACTIONAL NUMBERS:

01. Order fractions by finding least common multiple.
02. Add and subtract fractions with like and unlike denominators, using horizontal and vertical forms.
03. Add and subtract mixed fractions.
04. Multiply fractional numbers.
05. Read and write decimal fractions to thousandths.

Grade 6
Levels 14 and 15

E-MATH-6-2

STUDENTS WILL DEMONSTRATE SKILL IN USING FRACTIONAL NUMBERS (continued):

06. Add and subtract decimal fractions: tenths hundredths.
07. Read and write ratios.

E-MATH-6-3

STUDENTS WILL DEMONSTRATE SKILL WITH TECHNIQUES OF MEASUREMENT:

01. Identify the fractional parts of a day. Denominate numbers for hours, minutes, and seconds.
02. Use meter, kilometer, gram, kilogram.
03. Identify time zones in the U.S., Alaska, and Hawaii.
04. Read the thermometer using the celsius scale.

E-MATH-6-4

STUDENTS WILL DEMONSTRATE SKILL IN ORGANIZING AND INTERPRETING DATA:

01. Construct and interpret bar and line graphs using intervals larger than 5.
02. Graph and interpret two sets of data on one graph.
03. Determine the median as a statistical measure.

E-MATH-6-5

STUDENTS WILL DEMONSTRATE SKILL IN BASIC GEOMETRY:

01. Identify the intersection of two different lines or a line and a plane.
02. Identify and classify angles as right, acute, and obtuse.

Grade 6
Levels 14 and 15

E-MATH-6-5

STUDENTS WILL DEMONSTRATE SKILL IN BASIC GEOMETRY
(continued):

- 03. Construct, measure, and bisect angles.**
- 04. Identify and classify prisms: rectangular, cube, triangular.**

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